

**What is claimed is:**

1           1.    A multiplexer comprising:  
2           a first switching fabric comprising a plurality of inputs  
3   and a plurality of outputs;  
4           a plurality of transponders, one transponder of the  
5   plurality of transponders per output of the plurality of  
6   outputs of the first switching fabric, each transponder of the  
7   plurality of transponders comprising an input and an output,  
8   the input of said each transponder connected to the output of  
9   the first switching fabric associated with said each  
10   transponder;  
11          a plurality of output switches, one output switch of the  
12   plurality of output switches per transponder of the plurality  
13   of transponders, each output switch of the plurality of output  
14   switches comprising a first input, a second input, and an  
15   output, the first input of said each output switch being  
16   coupled to the output of the transponder associated with said  
17   each output switch;  
18          a link transmit interface comprising a plurality of inputs  
19   and an output, one input of the plurality of inputs of the link  
20   transmit interface per output switch of the plurality of output  
21   switches, each input of the plurality of inputs of the link

22 transmit interface coupled to the output of the output switch  
 23 associated with said each input of the link transmit interface,  
 24 the output of the link transmit interface being capable of  
 25 coupling channels appearing on the inputs of the link transmit  
 26 interface to an optical transmission link; and

27 a link receive interface comprising an input and a  
 28 plurality of outputs, one output of the plurality of outputs of  
 29 the link receive interface per output switch of the plurality  
 30 of output switches, each output of the plurality of outputs of  
 31 the link receive interface coupled to the second input of the  
 32 output switch associated with said each output of the link  
 33 receive interface, the link receive interface being capable of  
 34 coupling channels appearing on the input of the link receive  
 35 interface to the outputs of the link receive interface.

1 2. A multiplexer according to claim 1, wherein the first  
 2 switching fabric is a spatial switching fabric.

1 3. A multiplexer according to claim 1, wherein:  
 2 the first switching fabric is an optical spatial switching  
 3 fabric capable of connecting any of the inputs of the plurality  
 4 of inputs of the first switching fabric to any of the outputs  
 5 of the plurality of outputs of the first switching fabric;

6 each of the transponders comprises a fixed wavelength  
7 laser;

8 the link receive interface is a dense wavelength division  
9 multiplexing fiber-optic interface coupling discrete wavelength  
10 channels appearing on the input of the link receive interface  
11 to the outputs of the link receive interface, one wavelength  
12 channel per output of the link receive interface; and

13 the link transmit interface is a dense wavelength division  
14 multiplexing interface.

1 4. A multiplexer according to claim 3, further  
2 comprising a computer coupled to the first switching fabric and  
3 the output switches for configuring the output switches to  
4 select which of the channels appearing on the input of the link  
5 receive interface are coupled to the optical transmission link,  
6 and for configuring the first switching fabric to select paths  
7 of signals appearing at the inputs of the first switching  
8 fabric through the first switching fabric.

1 5. A multiplexer comprising:  
2 a first switching means comprising means for receiving a  
3 plurality of channels, a plurality of means for outputting

4 channels, and means for routing channels from the means for  
5 receiving to the means for outputting;

6 a plurality of transponder means, one transponder means  
7 per means for outputting, each transponder means for receiving  
8 a channel from the means for outputting associated with said  
9 each transponder means, and for converting the channel received  
10 by said each transponder means into a fixed-wavelength channel;

11 a plurality of second switching means, one second  
12 switching means per transponder means, each second switching  
13 means comprising a first input, a second input, and an output,  
14 said each second switching means capable of switching the first  
15 or second input of said each second switching means to the  
16 output of said second switching means, the first input of said  
17 each second switching means coupled to the transponder means  
18 associated with said each second switching means so as to  
19 receive the converted fixed-wavelength channel of the  
20 transponder means associated we said each second switching  
21 means;

22 a link transmit interface for receiving channels appearing  
23 on the outputs of the second switching means and coupling the  
24 channels appearing on the outputs of the second switching means  
25 to a first dense wavelength multiplexed fiber-optic link; and

26 a link receive interface for receiving channels from a  
27 second dense wavelength division multiplexed fiber-optic link  
28 and coupling the channels received from the second fiber-optic  
29 link into second inputs of the plurality of second switching  
30 means, one channel received from the second fiber-optic link  
31 per second switching means.

1 6. A multiplexer according to claim 5, further  
2 comprising computer means coupled to the first switching means  
3 and the plurality of second switching means for configuring the  
4 plurality of second switching means to select which of the  
5 channels received from the second fiber-optic link are coupled  
6 to the first fiber-optic link, and for configuring the first  
7 switching means to select paths of channels appearing at the  
8 means for receiving of the first switching means through the  
9 first switching means.

1 7. A multiplexer comprising:  
2 a first switching fabric comprising a plurality of inputs  
3 and a plurality of outputs;  
4 a plurality of receivers, one receiver of the plurality of  
5 receivers per output of the plurality of outputs of the first  
6 switching fabric, each receiver of the plurality of receivers

7 comprising an input coupled to the output of the first  
8 switching fabric associated with said each receiver;

9 a plurality of input switches, one input switch of the  
10 plurality of input switches per input of the plurality of  
11 inputs of the first switching fabric, each input switch of the  
12 plurality of input switches comprising an input, a first  
13 output, and a second output, the first output of said each  
14 input switch being coupled to the input of the first switching  
15 fabric associated with said each input switch;

16 a link receive interface comprising an input and a  
17 plurality of outputs, one output of the plurality of outputs of  
18 the link receive interface per input switch of the plurality of  
19 input switches, each output of the plurality of outputs of the  
20 link receive interface coupled to the input of the input switch  
21 associated with said each output of the link receive interface,  
22 the link receive interface being capable of coupling channels  
23 appearing on the input of the link receive interface to the  
24 outputs of the link receive interface; and

25 a link transmit interface comprising a plurality of inputs  
26 and an output, one input of the plurality of inputs of the link  
27 transmit interface per input switch of the plurality of input  
28 switches, each input of the plurality of inputs of the link

29 transmit interface coupled to the second output of the input  
30 switch associated with said each input of the link transmit  
31 interface, the output of the link transmit interface being  
32 capable of coupling channels appearing on the plurality of  
33 inputs of the link transmit interface to an optical  
34 transmission link.

1 8. A multiplexer according to claim 7, wherein the first  
2 switching fabric is a spatial switching fabric.

1 9. A multiplexer according to claim 7, wherein:  
2 the first switching fabric is an optical spatial switching  
3 fabric capable of connecting any of the inputs of the plurality  
4 of inputs of the first switching fabric to any of the outputs  
5 of the plurality of outputs of the first switching fabric;

6 the link receive interface is a dense wavelength division  
7 multiplexing fiber-optic interface coupling discrete wavelength  
8 channels appearing on the input of the link receive interface  
9 to the outputs of the link receive interface, one wavelength  
10 channel per output of the link receive interface; and

11 the link transmit interface is a dense wavelength division  
12 multiplexing interface.

1        10. A multiplexer according to claim 9, further  
2 comprising a computer coupled to the first switching fabric and  
3 the input switches for configuring the first switching fabric  
4 and the input switches to control paths of the discrete  
5 wavelength channels through the multiplexer.

1        11. A multiplexer comprising:

2        a first switching means comprising a plurality of means  
3 for receiving wavelength channels, a plurality of means for  
4 outputting wavelength channels, and means for routing channels  
5 from the means for receiving to the means for outputting;

6        a plurality of wavelength channel receivers for converting  
7 wavelength channels into electronic data flows, one receiver  
8 per means for outputting, each receiver coupled to the means  
9 for outputting associated with said each receiver;

10       a plurality of second switching means, one second  
11 switching means per means for receiving, each second switching  
12 means comprising an input, a first output, and a second output,  
13 said each second switching means being capable of switching the  
14 input of said each second switching means to the first or the  
15 second output of said each second switching means, the first  
16 output of said each second switching means coupled to the input



17 of the first switching means associated with said each second  
18 switching means;

19 a link receive interface for receiving wavelength channels  
20 from a second dense wavelength division multiplexed fiber-optic  
21 link and coupling the wavelength channels received from the  
22 second fiber-optic link into the inputs of the second switching  
23 means, one wavelength channel received from the second fiber-  
24 optic link per second switching means;

25 a link transmit interface for receiving wavelength  
26 channels appearing on the second outputs of the second  
27 switching means and coupling the channels appearing on the  
28 second outputs of the second switching means into a first dense  
29 wavelength multiplexed fiber-optic link.

1 12. A multiplexer according to claim 11, further  
2 comprising a computer coupled to the first switching means and  
3 the plurality of second switching means for configuring the  
4 first switching means and the second switching means to control  
5 paths of the wavelength channels through the multiplexer.

1 13. A multiplexer comprising:  
2 a first switching fabric comprising a plurality of inputs  
3 and a plurality of outputs;

a plurality of transponders, each transponder of the plurality of transponders comprising an input and an output, the input of said each transponder coupled to a different one of the outputs of the plurality of outputs of the first switching fabric;

a plurality of output switches, one output switch of the plurality of output switches per transponder of the plurality of transponders, each output switch of the plurality of output switches comprising a first input, a second input, and an output, the first input of said each output switch being coupled to the output of the transponder associated with said each output switch;

a link transmit interface comprising a plurality of inputs and an output, one input of the plurality of inputs of the link transmit interface per output switch of the plurality of output switches, each input of the plurality of inputs of the link transmit interface coupled to the output of the output switch associated with said each input of the link transmit interface, the output of the link transmit interface coupling channels appearing on the inputs of the link transmit interface to an optical transmission link;



1        14. A multiplexer according to claim 13, wherein the  
2 first switching fabric is a spatial switching fabric.

1        15. A multiplexer according to claim 13, wherein:  
2 the first switching fabric is an optical spatial switching  
3 fabric capable of connecting any of the inputs of the plurality  
4 of inputs of the first switching fabric to any of the outputs  
5 of the plurality of outputs of the first switching fabric;

6 each of the transponders of the plurality of transponders  
7 comprises a fixed wavelength laser;

8 the link receive interface is a dense wavelength division  
9 multiplexing fiber-optic interface coupling discrete wavelength  
10 channels appearing on the input of the link receive interface  
11 to the outputs of the link receive interface, one wavelength  
12 channel per output of the link receive interface; and

13 the link transmit interface is a dense wavelength division  
14 multiplexing interface.

1        16. A multiplexer according to claim 15, further  
2 comprising a computer coupled to the first switching fabric,  
3 the plurality of the input switches, and the plurality of the  
4 output switches for configuring the first switching fabric, the  
5 input switches, and the output switches to determine paths

6 through the multiplexer of the discrete wavelength channels  
7 appearing on the input of the link receive interface and of  
8 signals at the inputs of the first switching fabric.

1 17. A multiplexer comprising:

2 a first switching means comprising means for receiving a  
3 plurality of channels, a plurality of means for outputting  
4 channels, and means for routing channels from the means for  
5 receiving to the means for outputting;

6 a plurality of transponders means, one transponder means  
7 per means for outputting, each transponder means for receiving  
8 a channel from the means for outputting and converting it into  
9 a fixed-wavelength channel;

10 a plurality of second switching means, one second  
11 switching means per transponder means, each second switching  
12 means comprising a first input, a second input, and an output,  
13 said each second switching means capable of switching the first  
14 or the second input of said each second switching means to the  
15 output of said each second switching means, the first input of  
16 said each second switching means being coupled to the  
17 transponder means associated with said each second switching  
18 means so as to receive the converted fixed-wavelength channel

19 of the transponder means associated with said each second  
20 switching means;

21       a plurality of third switching means, one third switching  
22 means per second switching means, each third switching means  
23 comprising an input, a first output, and a second output, said  
24 each third switching means being capable of switching the input  
25 of said each third switching means to the first or the second  
26 output of said each third switching means, the second output of  
27 said each third switching means being coupled to the second  
28 input of the second switching means associated with the third  
29 switching means;

30 a plurality of wavelength channel receivers for converting  
31 wavelength channels into electronic data flows, one receiver  
32 per third switching means, each receiver coupled to the first  
33 output of the third switching means associated with said each  
34 receiver;

35       a link receive interface for receiving discrete wavelength  
36 channels from a second dense wavelength division multiplexed  
37 fiber-optic link and coupling the channels received from the  
38 second fiber-optic link into the inputs of the third switching  
39 means, one channel received from the second fiber-optic link  
40 per third switching means; and

41 a link transmit interface for receiving channels appearing  
42 on the outputs of the second switching means and coupling the  
43 channels appearing on the outputs of the second switching means  
44 to a first dense wavelength multiplexed fiber-optic link.

1 18. A multiplexer according to claim 17, further  
2 comprising computer means coupled to the first switching means,  
3 the plurality of the plurality of second switching means, and  
4 the plurality of the third switching means for configuring the  
5 first switching means, the second switching means, and the  
6 third switching means to determine paths through the  
7 multiplexer of the discrete wavelength channels appearing on  
8 the input of the link receive interface and of channels  
9 appearing at the means for receiving of the first switching  
10 means.

1 19. A multiplexer comprising:  
2 a first switching fabric comprising a plurality of inputs  
3 and a plurality of outputs;  
4 a plurality of receivers, one receiver of the plurality of  
5 receivers per output of the plurality of outputs of the first  
6 switching fabric, each receiver of the plurality of receivers

7 comprising an input coupled to the output of the first  
8 switching fabric associated with said each receiver;

9 a plurality of input switches, one input switch of the  
10 plurality of input switches per input of the plurality of  
11 inputs of the first switching fabric, each input switch of the  
12 plurality of input switches comprising an input, a first  
13 output, and a second output, the first output of said each  
14 input switch being coupled to the input of the first switching  
15 fabric associated with said each input switch;

16 a link receive interface comprising an input and a  
17 plurality of outputs, one output of the plurality of outputs of  
18 the link receive interface per input switch of the plurality of  
19 input switches, each output of the plurality of outputs of the  
20 link receive interface coupled to the input of the input switch  
21 associated with said each output of the link receive interface,  
22 the link receive interface being capable of coupling channels  
23 appearing on the input of the link receive interface to the  
24 outputs of the link receive interface;

25        a plurality of output switches, one output switch of the  
26 plurality of output switches per input switch of the plurality  
27 of input switches, each output switch of the plurality of  
28 output switches comprising a first input, a second input, and



29 an output, the second input of said each output switch being  
30 coupled to the second output of the input switch associated  
31 with said each output switch;

32 a link transmit interface comprising a plurality of inputs  
33 and an output, one input of the plurality of inputs of the link  
34 transmit interface per output switch of the plurality of output  
35 switches, each input of the plurality of inputs of the link  
36 transmit interface coupled to the output of the output switch  
37 associated with said each input of the link transmit interface,  
38 the output of the link transmit interface being capable of  
39 coupling channels appearing on the inputs of the link transmit  
40 interface to an optical transmission link.

1 20. A multiplexer according to claim 19, wherein the  
2 first switching fabric is a spatial switching fabric.

1 21. A multiplexer according to claim 19, wherein:  
2 the first switching fabric is an optical spatial switching  
3 fabric capable of connecting any of the inputs of the plurality  
4 of inputs of the first switching fabric to any of the outputs  
5 of the plurality of outputs of the first switching fabric;

6 the link receive interface is a dense wavelength division  
7 multiplexing fiber-optic interface coupling discrete wavelength

8 channels appearing on the input of the link receive interface  
9 to the outputs of the link receive interface, one wavelength  
10 channel per output of the link receive interface; and  
11 the link transmit interface is a dense wavelength division  
12 multiplexing interface.

1 22. A multiplexer according to claim 21, further  
2 comprising a computer coupled to the first switching fabric,  
3 the input switches, and the output switches, the computer being  
4 for configuring the first switching fabric, the input switches,  
5 and the output switches to control paths of the discrete  
6 wavelength channels through the multiplexer.

1 23. A multiplexer comprising:

2 a first switching means comprising a plurality of means  
3 for receiving wavelength channels, a plurality of means for  
4 outputting channels, and means for routing channels from the  
5 means for receiving to the means for outputting;

6 a plurality of wavelength channel receivers for converting  
7 wavelength channels into electronic data flows, one receiver  
8 per means for outputting, each receiver coupled to the means  
9 for outputting associated with said each receiver;

10 a plurality of second switching means, one second  
11 switching means per means for receiving, each second switching  
12 means comprising an input, a first output, and a second output,  
13 said each second switching means being capable of switching the  
14 input of said each second switching means to the first or the  
15 second output of said each second switching means, the first  
16 output of said each second switching means coupled to the input  
17 of the first switching means associated with said each second  
18 switching means;

19 a link receive interface for receiving wavelength channels  
20 from a second dense wavelength division multiplexed fiber-optic  
21 link and coupling the wavelength channels received from the  
22 second fiber-optic link into the inputs of the second switching  
23 means, one wavelength channel received from the second fiber-  
24 optic link per second switching means;

25 a plurality of third switching means, one third switching  
26 means per second switching means, each third switching means  
27 comprising a first input, a second input, and an output, said  
28 each third switching means being capable of switching the first  
29 or the second input of said each third switching means to the  
30 output of said each third switching means, the second input of  
31 said each third switching means being coupled to the second

32 output of the second switching means associated with said third  
33 switching means; and  
34 a link transmit interface for receiving wavelength  
35 channels appearing on the outputs of the third switching means  
36 and coupling the channels appearing on the outputs of the third  
37 switching means into a first dense wavelength multiplexed  
38 fiber-optic link.

1 24. A multiplexer according to claim 23, further  
2 comprising a computer coupled to the first switching means, the  
3 plurality of second switching means, and the plurality of third  
4 switching means for configuring the first switching means, the  
5 second switching means, and the third switching means to  
6 control paths of the wavelength channels through the  
7 multiplexer.

1 25. A multiplexer comprising:  
2 a first switching fabric comprising a plurality of inputs  
3 and a plurality of outputs;  
4 a plurality of transponders, one transponder of the  
5 plurality of transponders per output of the plurality of  
6 outputs of the first switching fabric, each transponder of the  
7 plurality of transponders comprising an input and an output,

the input of said each transponder coupled to the output of the first switching fabric associated with said each transponder;

a plurality of output switches, one output switch of the plurality of output switches per transponder of the plurality of transponders, each output switch of the plurality of output switches comprising a first input, a second input, and an output, the first input of said each output switch being coupled to the output of the transponder associated with said each output switch;

a link transmit interface comprising a plurality of inputs and an output, one input of the plurality of inputs of the link transmit interface per output switch of the plurality of output switches, each input of the plurality of inputs of the link transmit interface coupled to the output of the output switch associated with said each input of the link transmit interface, the link transmit interface being capable of coupling channels appearing on the inputs of the link transmit interface to the output of the link transmit interface;

a link receive interface comprising an input and a plurality of outputs, one output of the plurality of outputs of the link receive interface per output switch of the plurality of output switches, each output of the plurality of outputs of

30 the link receive interface coupled to the second input of the  
31 output switch associated with said each output of the link  
32 receive interface, the link receive interface being capable of  
33 coupling channels appearing on the input of the link receive  
34 interface to the outputs of the link receive interface;

35 a multiplexer bypass connection comprising a channel input  
36 and a channel output;

37 a channel splitter coupled to an optical receive link, to  
38 the input of the link receive interface, and to the channel  
39 input of the multiplexer bypass connection, the channel  
40 splitter being capable of receiving a first plurality of  
41 channels and a second plurality of channels from the optical  
42 receive link, transmitting the first plurality of channels to  
43 the input of the link receive interface, and transmitting the  
44 second plurality of channels to the multiplexer bypass  
45 connection; and

46 a channel combiner coupled to an optical transmit link, to  
47 the output of the link transmit interface, and to the channel  
48 output of the multiplexer bypass connection, the channel  
49 combiner being capable of receiving the second plurality of  
50 channels from the output of the multiplexer bypass connection  
51 and the channels coupled to the output of the link transmit

52 interface, and coupling the channels received by the channel  
53 combiner into the optical transmit link.

1 26. A multiplexer according to claim 25, wherein:

2 the first switching fabric is an optical spatial switching  
3 fabric capable of connecting any of the inputs of the plurality  
4 of inputs of the first switching fabric to any of the outputs  
5 of the plurality of outputs of the first switching fabric;

6 each of the transponders of the plurality of transponders  
7 comprises a fixed wavelength laser;

8 the link receive interface is a dense wavelength division  
9 multiplexing fiber-optic interface coupling discrete wavelength  
10 channels appearing on the input of the link receive interface  
11 to the outputs of the link receive interface, one wavelength  
12 channel per output of the link receive interface; and

13 the link transmit interface is a dense wavelength division  
14 multiplexing interface.

1 27. A multiplexer according to claim 26, further  
2 comprising a computer coupled to the first switching fabric and  
3 the output switches for configuring the output switches to  
4 select which of the channels appearing on the input of the link  
5 receive interface are coupled to the optical transmission link,

6 and for configuring the first switching fabric to select paths  
7 of signals appearing at the inputs of the first switching  
8 fabric through the first switching fabric.

1 28. A multiplexer according to claim 27, wherein:  
2 the channel splitter comprises a circulator; and  
3 the channel combiner comprises a circulator.

1 29. A multiplexer according to claim 27, wherein the  
2 channel splitter comprises a wavelength filter for separating  
3 the first plurality of channels from the second plurality of  
4 channels.

1 30. A multiplexer comprising:  
2 a first switching means comprising a plurality of means  
3 for receiving channels, a plurality of means for outputting  
4 channels, and means for routing channels from the means for  
5 receiving to the means for outputting;  
6 a plurality of transponder means, one transponder means  
7 per means for outputting, each transponder means for receiving  
8 a channel from the means for outputting associated with said  
9 each transponder means and converting the channel received by  
10 said each transponder means into a fixed-wavelength channel;



11 a plurality of second switching means, one second  
 12 switching means per transponder means, each second switching  
 13 means comprising a first input, a second input, and an output,  
 14 said each second switching means capable of switching the first  
 15 or the second input of said each second switching means to the  
 16 output of said each second switching means, the first input of  
 17 said each second switching means coupled to the transponder  
 18 means associated with said each second switching means so as to  
 19 receive the converted fixed-wavelength channel of the  
 20 transponder means associated we said each second switching  
 21 means;

22 a link transmit interface means comprising an output, the  
 23 link transmit interface means being for receiving channels  
 24 appearing on the outputs of the second switching means and  
 25 coupling the channels appearing on the outputs of the second  
 26 switching means into the output of the link transmit interface  
 27 means;

28 a link receive interface means comprising an input for  
 29 receiving dense wavelength division multiplexed channels and  
 30 coupling the received wavelength division multiplexed channels  
 31 into the second inputs of the plurality of second switching

32 means, one wavelength division multiplexed channel received by  
33 the link receive interface means per second switching means;

34 a multiplexer bypass connection comprising a channel input  
35 and a channel output;

36 a channel splitter means coupled to an optical receive  
37 link, to the input of the link receive interface means, and to  
38 the channel input of the multiplexer bypass connection, the  
39 channel splitter means being for receiving a first plurality of  
40 channels and a second plurality of channels from the optical  
41 receive link, transmitting the first plurality of channels to  
42 the link receive interface means, and transmitting the second  
43 plurality of channels to the multiplexer bypass connection; and

44 a channel combiner means coupled to an optical transmit  
45 link, to the output of the link transmit interface means, and  
46 to the channel output of the multiplexer bypass connection, the  
47 channel combiner being for receiving the second plurality of  
48 channels from the output of the multiplexer bypass connection  
49 and the channels coupled to the output of the link transmit  
50 interface means, and for coupling the channels received by the  
51 channel combiner means into the optical transmit link.

1 31. A multiplexer according to claim 30, further  
2 comprising computer means coupled to the first switching means

3 and the plurality of second switching means for configuring the  
4 plurality of second switching means to select which of the  
5 channels at the inputs of the second switching means are  
6 coupled to the optical transmit link, and for configuring the  
7 first switching means to select paths of channels appearing at  
8 the means for receiving of the first switching means through  
9 the first switching means.

1 32. A multiplexer comprising:

2 a first switching fabric comprising a plurality of inputs  
3 and a plurality of outputs;

4 a plurality of receivers, one receiver of the plurality of  
5 receivers per output of the plurality of outputs of the first  
6 switching fabric, each receiver of the plurality of receivers  
7 comprising an input coupled to the output of the first  
8 switching fabric associated with said each receiver;

9 a plurality of input switches, one input switch of the  
10 plurality of input switches per input of the plurality of  
11 inputs of the first switching fabric, each input switch of the  
12 plurality of input switches comprising an input, a first  
13 output, and a second output, the first output of said each  
14 input switch being coupled to the input of the first switching  
15 fabric associated with said each input switch;

16 a link receive interface comprising an input and a  
 17 plurality of outputs, one output of the plurality of outputs of  
 18 the link receive interface per input switch of the plurality of  
 19 input switches, each output of the plurality of outputs of the  
 20 link receive interface coupled to the input of the input switch  
 21 associated with said each output of the link receive interface,  
 22 the link receive interface being capable of coupling channels  
 23 appearing on the input of the link receive interface to the  
 24 outputs of the link receive interface;

25 a link transmit interface comprising a plurality of inputs  
 26 and an output, one input of the plurality of inputs of the link  
 27 transmit interface per input switch of the plurality of input  
 28 switches, each input of the plurality of inputs of the link  
 29 transmit interface coupled to the second output of the input  
 30 switch associated with said each input of the link transmit  
 31 interface, the link transmit interface being capable of  
 32 coupling channels appearing on the inputs of the link transmit  
 33 interface to the output of the link transmit interface;

34 a multiplexer bypass connection comprising a channel input  
 35 and a channel output;

36 a channel splitter coupled to an optical receive link, to  
 37 the input of the link receive interface, and to the channel

38 input of the multiplexer bypass connection, the channel  
39 splitter being capable of receiving a first plurality of  
40 channels and a second plurality of channels from the optical  
41 receive link, transmitting the first plurality of channels to  
42 the input of the link receive interface, and transmitting the  
43 second plurality of channels to the multiplexer bypass  
44 connection; and

45 a channel combiner coupled to an optical transmit link, to  
46 the output of the link transmit interface, and to the channel  
47 output of the multiplexer bypass connection, the channel  
48 combiner being capable of receiving the second plurality of  
49 channels from the output of the multiplexer bypass connection  
50 and the channels coupled to the output of the link transmit  
51 interface, and coupling the channels received by the channel  
52 combiner into the optical transmit link.

1 33. A multiplexer according to claim 32, wherein:

2 the first switching fabric is an optical spatial switching  
3 fabric capable of connecting any of the inputs of the plurality  
4 of inputs of the first switching fabric to any of the outputs  
5 of the plurality of outputs of the first switching fabric;

6 the link receive interface is a dense wavelength division  
7 multiplexing fiber-optic interface coupling discrete wavelength

8 channels appearing on the input of the link receive interface  
9 to the outputs of the link receive interface, one wavelength  
10 channel per output of the link receive interface; and  
11 the link transmit interface is a dense wavelength division  
12 multiplexing interface.

1 34. A multiplexer according to claim 33, further  
2 comprising a computer coupled to the first switching fabric and  
3 the input switches for configuring the first switching fabric  
4 and the input switches to control paths of the discrete  
5 wavelength channels through the multiplexer.

1 35. A multiplexer according to claim 34, wherein:  
2 the channel splitter comprises a circulator; and  
3 the channel combiner comprises a circulator.

1 36. A multiplexer according to claim 34, wherein the  
2 channel splitter comprises a wavelength filter for separating  
3 the first plurality of channels from the second plurality of  
4 channels.

1 37. A multiplexer comprising:  
2 a first switching means comprising a plurality of means  
3 for receiving wavelength channels, a plurality of means for

4 outputting wavelength channels, and means for routing  
5 wavelength channels from the means for receiving to the means  
6 for outputting;

7 a plurality of wavelength channel receivers for converting  
8 wavelength channels into electronic data flows, one receiver  
9 per means for outputting, each receiver coupled to the means  
10 for outputting associated with said each receiver;

11 a plurality of second switching means, one second  
12 switching means per means for receiving, each second switching  
13 means comprising an input, a first output, and a second output,  
14 said each second switching means capable of switching the input  
15 of said each second switching means to the first or the second  
16 output of said each second switching means, the first output of  
17 said each second switching means coupled to the input of the  
18 first switching means associated with said each second  
19 switching means;

20 a link receive interface means comprising an input, for  
21 receiving dense wavelength division multiplexed channels  
22 appearing at the input of the link receive interface means and  
23 coupling the received wavelength division multiplexed channels  
24 into the inputs of the second switching means, one received

25 wavelength division multiplexed channel per second switching  
26 means;

27 a link transmit interface means comprising an output, the  
28 link transmit interface means being for receiving wavelength  
29 channels appearing on the second outputs of the second  
30 switching means and coupling the channels appearing on the  
31 second outputs of the second switching means into the output of  
32 the link transmit interface means;

33 a multiplexer bypass connection comprising a channel input  
34 and a channel output;

35 a channel splitter means coupled to an optical receive  
36 link, to the input of the link receive interface means, and to  
37 the channel input of the multiplexer bypass connection, the  
38 channel splitter means being for receiving a first plurality of  
39 wavelength channels and a second plurality of wavelength  
40 channels from the optical receive link, transmitting the first  
41 plurality of channels to the link receive interface means, and  
42 transmitting the second plurality of channels to the channel  
43 input of the multiplexer bypass connection; and

44 a channel combiner means coupled to an optical transmit  
45 link, to the output of the link transmit interface means, and  
46 to the channel output of the multiplexer bypass connection, the



47 channel combiner being for receiving the second plurality of  
48 channels from the output of the multiplexer bypass connection  
49 and the channels coupled to the output of the link transmit  
50 interface means, and for coupling the channels received by the  
51 channel combiner means into the optical transmit link.

1 38. A multiplexer according to claim 37, further  
2 comprising computer means coupled to the first switching means  
3 and the plurality of second switching means for configuring the  
4 first switching means and the plurality of second switching  
5 means to control paths of the first plurality of wavelength  
6 channels through the multiplexer.

1 39. A multiplexer comprising:

2 a first switching fabric comprising a plurality of inputs  
3 and a plurality of outputs;

4 a plurality of transponders, each transponder of the  
5 plurality of transponders comprising an input and an output,  
6 the input of said each transponder connected to a different one  
7 of the outputs of the plurality of outputs of the first  
8 switching fabric;

9 a plurality of output switches comprising a first set of  
10 output switches and a second set of output switches, one output

11 switch of the plurality of output switches per transponder of  
12 the plurality of transponders, each output switch of the  
13 plurality of output switches comprising a first input, a second  
14 input, and an output, the first input of said each output  
15 switch being coupled to the output of the transponder  
16 associated with said each output switch;

17 a first link transmit interface comprising a plurality of  
18 inputs and an output, one input of the plurality of inputs of  
19 the first link transmit interface per output switch of the  
20 first set of output switches, each input of the plurality of  
21 inputs of the first link transmit interface coupled to the  
22 output of the output switch associated with said each input of  
23 the first link transmit interface, the first link transmit  
24 interface being capable of coupling channels appearing on the  
25 inputs of the first link transmit interface to the output of  
26 the first link transmit interface;

27 a second link transmit interface comprising a plurality of  
28 inputs and an output, one input of the plurality of inputs of  
29 the second link transmit interface per output switch of the  
30 second set of output switches, each input of the plurality of  
31 inputs of the second link transmit interface coupled to the  
32 output of the output switch associated with said each input of

33 the second link transmit interface, the second link transmit  
34 interface being capable of coupling channels appearing on the  
35 inputs of the second link transmit interface to the output of  
36 the second link transmit interface;

37 a plurality of input switches comprising a first set of  
38 input switches and a second set of input switches, one input  
39 switch of the first set of input switches per output switch of  
40 the first set of output switches, one input switch of the  
41 second set of input switches per output switch of the second  
42 set of output switches, each input switch of the plurality of  
43 input switches comprising an input, a first output, and a  
44 second output, the second output of said each input switch  
45 coupled to the second input of the output switch associated  
46 with said each input switch;

47 a first link receive interface comprising an input and a  
48 plurality of outputs, one output of the plurality of outputs of  
49 the first link receive interface per input switch of the first  
50 set of input switches, each output of the plurality of outputs  
51 of the first link receive interface coupled to the input of the  
52 input switch associated with said each output of the first link  
53 receive interface, the first link receive interface being  
54 capable of coupling channels appearing on the input of the

55 first link receive interface to the outputs of the first link  
 56 receive interface, one said channel appearing on the input of  
 57 the first link receive interface per output of the plurality of  
 58 outputs of the first link receive interface;

59 a second link receive interface comprising an input and a  
 60 plurality of outputs, one output of the plurality of outputs of  
 61 the second link receive interface per input switch of the  
 62 second set of input switches, each output of the plurality of  
 63 outputs of the second link receive interface coupled to the  
 64 input of the input switch associated with said each output of  
 65 the second link receive interface, the second link receive  
 66 interface being capable of coupling channels appearing on the  
 67 input of the second link receive interface to the outputs of  
 68 the second link receive interface, one said channel appearing  
 69 on the input of the second link receive interface per output of  
 70 the plurality of outputs of the second link receive interface;

71 a second switching fabric comprising a plurality of inputs  
 72 and a plurality of outputs, one input of the plurality of  
 73 inputs of the second switching fabric per input switch of the  
 74 plurality of input switches, each input of the plurality of  
 75 inputs of the second switching fabric coupled to the first

76 output of the input switch associated with said each input of  
77 the second switching fabric; and

78 a plurality of receivers, one receiver of the plurality of  
79 receivers per output of the plurality of outputs of the second  
80 switching fabric, each receiver of the plurality of receivers  
81 comprising an input, the input of said each receiver coupled to  
82 the output of the second switching fabric associated with said  
83 each receiver.

continued on next page

1 40. A multiplexer according to claim 39, wherein the  
2 first switching fabric and the second switching fabric are  
3 spatial switching fabrics.

1 41. A multiplexer according to claim 39, wherein:

2 the first switching fabric is an optical spatial switching  
3 fabric capable of connecting any of the inputs of the plurality  
4 of inputs of the first switching fabric to any of the outputs  
5 of the plurality of outputs of the first switching fabric;

6 the second switching fabric is an optical spatial  
7 switching fabric capable of connecting any of the inputs of the  
8 plurality of inputs of the second switching fabric to any of  
9 the outputs of the plurality of outputs of the second switching  
10 fabric;

11 each of the transponders of the plurality of transponders  
12 comprises a fixed wavelength laser;

13 the first link receive interface is a dense wavelength  
14 division multiplexing fiber-optic interface coupling discrete  
15 wavelength channels appearing on the input of the first link  
16 receive interface to the outputs of the first link receive  
17 interface;

18 the second link receive interface is a dense wavelength  
19 division multiplexing fiber-optic interface coupling discrete  
20 wavelength channels appearing on the input of the second link  
21 receive interface to the outputs of the second link receive  
22 interface;

23 the first and the second link transmit interfaces are  
24 dense wavelength division multiplexing interfaces.

1 42. A multiplexer according to claim 41, further  
2 comprising a computer coupled to the first switching fabric,  
3 the second switching fabric, the plurality of the input  
4 switches, and the plurality of the output switches for  
5 configuring the first switching fabric, the second switching  
6 fabric, the input switches, and the output switches to  
7 determine paths of the discrete wavelength channels appearing  
8 on the inputs of the first and second link receive interfaces

9 and channels at the inputs of the first switching fabric  
10 through the multiplexer.

1 43. A multiplexer according to claim 42, further  
2 comprising:

3 a first multiplexer bypass connection comprising a channel  
4 input and a channel output;

5 a first channel splitter coupled to a first optical  
6 receive link, to the input of the first link receive interface,  
7 and to the channel input of the first multiplexer bypass  
8 connection, the first channel splitter capable of receiving a  
9 first plurality of channels and a second plurality of channels  
10 from the first optical receive link, transmitting the first  
11 plurality of channels to the input of the first link receive  
12 interface, and transmitting the second plurality of channels to  
13 the first multiplexer bypass connection;

14 a first channel combiner coupled to a first optical  
15 transmit link, to the output of the first link transmit  
16 interface, and to the channel output of the first multiplexer  
17 bypass connection, the first channel combiner capable of  
18 receiving the second plurality of channels from the channel  
19 output of the first multiplexer bypass connection and the  
20 channels coupled to the output of the first link transmit

21 interface, and coupling the channels received by the first  
22 channel combiner into the first optical transmit link;  
23 a second multiplexer bypass connection comprising a  
24 channel input and a channel output;  
25 a second channel splitter coupled to a second optical  
26 receive link, to the input of the second link receive  
27 interface, and to the channel input of the second multiplexer  
28 bypass connection, the second channel splitter being capable of  
29 receiving a third plurality of channels and a fourth plurality  
30 of channels from the second optical receive link, transmitting  
31 the third plurality of channels to the input of the second link  
32 receive interface, and transmitting the fourth plurality of  
33 channels to the second multiplexer bypass connection; and  
34 a second channel combiner coupled to a second optical  
35 transmit link, to the output of the second link transmit  
36 interface, and to the channel output of the second multiplexer  
37 bypass connection, the second channel combiner being capable of  
38 receiving the fourth plurality of channels from the channel  
39 output of the second multiplexer bypass connection and the  
40 channels coupled to the output of the second link transmit  
41 interface, and coupling the channels received by the second  
42 channel combiner into the second optical transmit link.



44. A method for restoring a communication path between a first input of the plurality of inputs of the first switching fabric of the multiplexer according to claim 42 and a second node, the multiplexer and the second node being connected in an optical network by a first optical fiber and a second optical fiber, wherein the first input of the multiplexer communicates with the second node through a first channel transmitted by the first link transmit interface and the first optical fiber, the method comprises:

detecting failure of a transmission path through the first optical fiber;

identifying a second channel available for communication between the multiplexer and the second node, the second node being capable of receiving the second channel, the second channel capable of being transmitted by the second link transmit interface through the second optical fiber;

configuring the first switching fabric to connect the first input of the first switching fabric associated with a first transponder of the plurality of transponders, the first transponder comprises a laser with a fixed wavelength associated with the second channel;

22 configuring the output switches to connect the output of  
23 the first transponder to the second link transmit interface;  
24 and  
25 notifying the second node of switchover to the second  
26 channel.

1 45. A method for restoring a communication path between a  
2 first receiver of the plurality of receivers of the multiplexer  
3 according to claim 42 and a second node, the multiplexer and  
4 the second node being connected in an optical network by a  
5 first optical fiber and a second optical fiber, wherein the  
6 first receiver communicates with the second node through a  
7 first channel transmitted by the first optical fiber and the  
8 first link receive interface, the method comprises:

9 detecting failure of a transmission path through the first  
10 optical fiber;

11 identifying a second channel available for communication  
12 between the first receiver and the second node, the second node  
13 being capable of transmitting the second channel, the second  
14 channel capable of being received by the second link receive  
15 interface through the second optical fiber;

16 configuring the second switching fabric and the input  
17 switches to route the second channel to the first receiver; and

18 notifying the second node of switchover to the second  
19 channel.

1 46. A multiplexer comprising:

2 a first switching means comprising a plurality of means  
3 for receiving channels, a plurality of means for outputting  
4 channels, and a means for routing channels from the means for  
5 receiving of the first switching means to the means for  
6 outputting of the first switching means, the plurality of the  
7 means for receiving of the first switching means comprising a  
8 first subset of the means for receiving of the first switching  
9 means, the means for routing of the first switching means  
10 comprising means for routing each channel input through the  
11 first subset of the means for receiving of the first switching  
12 means to at least two of the means for outputting of the first  
13 switching means;

14 a plurality of transponder means, one transponder means  
15 per means for outputting of the first switching means, each  
16 transponder means for receiving a channel from the means for  
17 outputting of the first switching means associated with said  
18 each transponder means, and for converting the channel received  
19 by said each transponder means into a fixed-wavelength channel;

20 a plurality of output switching means comprising a first  
21 set of output switching means and a second set of output  
22 switching means, one output switching means per transponder  
23 means, each output switching means comprising a first input, a  
24 second input, and an output, said each output switching means  
25 capable of switching the first or the second input of said each  
26 output switching means to the output of said each output  
27 switching means, the first input of said each output switching  
28 means being coupled to the transponder means associated with  
29 said each output switching means for receiving the channel  
30 converted by said transponder means associated with said each  
31 output switching means;

32 a first link transmit interface for receiving channels  
33 appearing on the outputs of the first set of output switching  
34 means and coupling the channels appearing on the outputs of the  
35 first set of output switching means into a first dense  
36 wavelength division multiplexed fiber-optic link;

37 a second link transmit interface for receiving channels  
38 appearing on the outputs of the second set of output switching  
39 means and coupling the channels appearing on the outputs of the  
40 second set of output switching means into a second dense  
41 wavelength division multiplexed fiber-optic link;

42 a plurality of input switching means comprising a first  
43 set of input switching means and a second set of input  
44 switching means, one input switching means of the first set of  
45 input switching means per output switching means of the first  
46 set of output switching means, one input switching means of the  
47 second set of input switching means per output switching means  
48 of the second set of output switching means, each input  
49 switching means comprising an input, a first output, and a  
50 second output, said each input switching means capable of  
51 switching the input of said each input switching means to the  
52 first or the second output of said each input switching means,  
53 the second output of said each input switching means coupled to  
54 the second input of the output switching means associated with  
55 said each input switching means;

56 a first link receive interface for receiving discrete  
57 wavelength channels from a third dense wavelength division  
58 multiplexed fiber-optic link and for coupling the channels  
59 received from the third fiber-optic link into the inputs of the  
60 first set of input switching means, one channel received from  
61 the third fiber-optic link per input switching means of the  
62 first set of input switching means;

63 a second link receive interface for receiving discrete  
 64 wavelength channels from a fourth dense wavelength division  
 65 multiplexed fiber-optic link and for coupling the channels  
 66 received from the fourth fiber-optic link into the inputs of  
 67 the second set of input switching means, one channel received  
 68 from the fourth fiber-optic link per input switching means of  
 69 the second set of input switching means;

70 a second switching means comprising a plurality of means  
 71 for receiving channels, a plurality of means for outputting  
 72 channels, and a means for routing channels from the means for  
 73 receiving of the second switching means to the means for  
 74 outputting of the second switching means, the plurality of the  
 75 means for receiving of the second switching means comprising a  
 76 second subset of the means for receiving of the second  
 77 switching means, the means for routing of the second switching  
 78 means comprising means for routing each channel input through  
 79 the second subset of the means for receiving of the second  
 80 switching means to at least two of the means for outputting of  
 81 the second switching means; and

82 a plurality of wavelength channel receivers for converting  
 83 wavelength channels into electronic data flows, one receiver  
 84 per means for outputting of the second switching means, each

85 wavelength channel receiver coupled to the means for outputting  
86 of the second switching means associated with said each  
87 receiver.

1 47. A multiplexer according to claim 46, further  
2 comprising computer means coupled to the first switching means,  
3 the second switching means, the plurality of input switching  
4 means, and the plurality of output switching means, the  
5 computer means being for configuring the first switching means,  
6 the second switching means, the plurality of the input  
7 switching means, and the plurality of output switching means to  
8 control paths through the multiplexer of the channels received  
9 from the third and fourth fiber-optic links and of channels  
10 received by the means for receiving of the first switching  
11 means.

1 48. A multiplexer comprising:  
2 a first switching fabric comprising a plurality of inputs  
3 and a plurality of outputs;  
4 a plurality of transponders, each transponder of the  
5 plurality of transponders comprising an input and an output,  
6 the input of said each transponder connected to a different one

7 of the outputs of the plurality of outputs of the first  
8 switching fabric;

9 a plurality of output switches, one output switch of the  
10 plurality of output switches per transponder of the plurality  
11 of transponders, each output switch of the plurality of output  
12 switches comprising a first input, a second input, and an  
13 output, the first input of said each output switch being  
14 coupled to the output of the transponder associated with said  
15 each output switch;

16        a link transmit interface comprising a plurality of inputs  
17        and an output, one input of the plurality of inputs of the link  
18        transmit interface per output switch of the plurality of output  
19        switches, each input of the plurality of inputs of the link  
20        transmit interface coupled to the output of the output switch  
21        associated with said each input of the link transmit interface,  
22        the output of the link transmit interface coupling channels  
23        appearing on the inputs of the link transmit interface to the  
24        output of the link transmit interface;

25        a plurality of input switches, one input switch of the  
26 plurality of input switches per output switch of the plurality  
27 of output switches, each input switch of the plurality of input  
28 switches comprising an input, a first output, and a second



29 output, the second output of said each input switch coupled to  
30 the second input of the output switch associated with said each  
31 input switch;

32 a link receive interface comprising an input and a  
33 plurality of outputs, one output of the plurality of outputs of  
34 the link receive interface per input switch of the plurality of  
35 input switches, each output of the plurality of outputs of the  
36 link receive interface coupled to the input of the input switch  
37 associated with said each output of the link receive interface,  
38 the link receive interface being capable of coupling channels  
39 appearing on the input of the link receive interface to the  
40 outputs of the link receive interface, one said channel  
41 appearing on the input of the link receive interface per output  
42 of the plurality of outputs of the link receive interface;

43 a second switching fabric comprising a plurality of inputs  
44 and a plurality of outputs, one input of the plurality of  
45 inputs of the second switching fabric per input switch of the  
46 plurality of input switches, each input of the plurality of  
47 inputs of the second switching fabric coupled to the first  
48 output of the input switch associated with said each input of  
49 the second switching fabric; and

50 a plurality of receivers, one receiver of the plurality of  
51 receivers per output of the plurality of outputs of the second  
52 switching fabric, each receiver of the plurality of receivers  
53 comprising an input, the input of said each receiver coupled to  
54 the output of the second switching fabric associated with said  
55 each receiver.

1 49. A multiplexer according to claim 48, wherein the  
2 first switching fabric and the second switching fabric are  
3 spatial switching fabrics.

1 50. A multiplexer according to claim 48, wherein:

2 the first switching fabric is an optical spatial switching  
3 fabric capable of connecting any of the inputs of the plurality  
4 of inputs of the first switching fabric to any of the outputs  
5 of the plurality of outputs of the first switching fabric;

6 the second switching fabric is an optical spatial  
7 switching fabric capable of connecting any of the inputs of the  
8 plurality of inputs of the second switching fabric to any of  
9 the outputs of the plurality of outputs of the second switching  
10 fabric;

11 each of the transponders of the plurality of transponders  
12 comprises a fixed wavelength laser;

13 the link receive interface is a dense wavelength division  
14 multiplexing fiber-optic interface;  
15 the link transmit interface is a dense wavelength division  
16 multiplexing interface.

1 51. A multiplexer according to claim 50, further  
2 comprising a computer coupled to the first switching fabric,  
3 the second switching fabric, the plurality of the input  
4 switches, and the plurality of the output switches for  
5 configuring the first switching fabric, the second switching  
6 fabric, the input switches, and the output switches to  
7 determine paths through the multiplexer of the channels  
8 appearing on the input of the link receive interface and  
9 channels at the inputs of the first switching fabric.

1 52. A multiplexer comprising:  
2 a first switching means comprising a plurality of means  
3 for receiving channels, a plurality of means for outputting  
4 channels, and a means for routing channels from the means for  
5 receiving of the first switching means to the means for  
6 outputting of the first switching means, the plurality of the  
7 means for receiving of the first switching means comprising a  
8 first subset of the means for receiving of the first switching

9 means, the means for routing of the first switching means  
 10 comprising means for routing each channel input through the  
 11 first subset of the means for receiving of the first switching  
 12 means to at least two of the means for outputting of the first  
 13 switching means;

14 a plurality of transponder means, one transponder means  
 15 per means for outputting of the first switching means, each  
 16 transponder means for receiving a channel from the means for  
 17 outputting of the first switching means associated with said  
 18 each transponder means, and for converting the channel received  
 19 by said each transponder means into a fixed-wavelength channel;

20 a plurality of output switching means, one output  
 21 switching means per transponder means, each output switching  
 22 means comprising a first input, a second input, and an output,  
 23 said each output switching means being for switching channels  
 24 between the first or the second input of said each output  
 25 switching means and the output of said each output switching  
 26 means, the first input of said each output switching means  
 27 being coupled to the transponder means associated with said  
 28 each output switching means for receiving the channel converted  
 29 by said transponder means associated with said each output  
 30 switching means;

31 a link transmit interface for receiving channels appearing  
32 on the outputs of the output switching means and coupling the  
33 channels appearing on the outputs of the output switching means  
34 into a first dense wavelength division multiplexed fiber-optic  
35 link;

36 a plurality of input switching means, one input switching  
37 means per output switching means, each input switching means  
38 comprising an input, a first output, and a second output, said  
39 each input switching means being for switching channels between  
40 the input of said each input switching means and the first and  
41 the second outputs of said each input switching means, the  
42 second output of said each input switching means coupled to the  
43 second input of the output switching means associated with said  
44 each input switching means;

45 a link receive interface for receiving discrete wavelength  
46 channels from a second dense wavelength division multiplexed  
47 fiber-optic link and for coupling the channels received from  
48 the second fiber-optic link into the inputs of the input  
49 switching means, one channel received from the second fiber-  
50 optic link per input switching means;

51 a second switching means comprising a plurality of means  
52 for receiving channels, a plurality of means for outputting

channels, and a means for routing channels from the means for receiving of the second switching means to the means for outputting of the second switching means, the plurality of the means for receiving of the second switching means comprising a second subset of the means for receiving of the second switching means, the means for routing of the second switching means comprising means for routing each channel input through the second subset of the means for receiving of the second switching means to at least two of the means for outputting of the second switching means; and

a plurality of wavelength channel receivers for converting wavelength channels into electronic data flows, one receiver per means for outputting of the second switching means, each wavelength channel receiver coupled to the means for outputting of the second switching means associated with said each receiver.

53. A multiplexer according to claim 52, further comprising computer means coupled to the first switching means, the second switching means, the plurality of input switching means, and the plurality of output switching means, the computer means being for configuring the first switching means, the second switching means, the plurality of the input

